ITEM - SLURRY SEAL

Note to C&S:

This specification is to be used in conjunction with Stored Specifications "1001MATL" and "104ENVIR". Stored Specifications "404SLRY" and "404BITUM" shall ***not*** *be used in conjunction with Slurry Seal.*

1. Description:

The work described herein shall consist of constructing a slurry seal on an existing asphaltic concrete pavement surface. This specification covers the materials, equipment, and construction procedures for resurfacing of existing paved surfaces with a slurry seal. The slurry seal shall be a mixture of mineral aggregate, polymer modified emulsified asphalt, mineral filler, water, and other additives, properly proportioned, mixed, and uniformly spread on the surface of pavement as specified herein and as directed by the Engineer.

The slurry seal shall be applied as a homogeneous mat, adhere firmly to the prepared surface, and have a skid-resistant surface texture. The finished product shall have a uniform appearance and it shall be able to accept controlled vehicular traffic within one hour after application without damage.

The contractor shall supply all materials, labor, and equipment necessary to perform the slurry seal work as described herein, or as directed by the Engineer.

The materials furnished and installed, along with all other work performed shall conform to all the applicable Department, State, Federal, and local requirements. This includes the following: current Manual on Uniform Traffic Control Devices (MUTCD) as adopted by the Department, and the Department's supplement to this document; ADOT Standard Specifications for Road and Bridge Construction, current edition, plus all applicable Stored Specifications; ADOT Standard Drawings for Signing and Marking current editions; and any documents referenced directly in the specifications.

References are made herein to the following organizations:

- AASHTO American Association of State Highway and Transportation Officials
- ASTM American Society for Testing and Materials
- ISSA International Slurry Seal Association
- ADOT Arizona Department of Transportation

2. Materials:

2.01 General:

All materials shall be approved by the Engineer prior to the start of construction.

The Engineer reserves the right to sample and test any materials used on the project. All materials that do not meet specifications will be rejected.

The information given in Table 1 shall be used to estimate the quantities of emulsified asphalt and dry mineral aggregate for Type II and Type III slurry seals. Application rates are affected by the unit weight and gradation of the mineral aggregate and the demand of the surface to which the slurry seal is being applied. Exact quantities of emulsified asphalt and dry mineral aggregate shall be determined by mix design, or as directed by the Engineer.

TABLE 1

Material	Type II Slurry Seal	Type III Slurry Seal
Emulsified Asphalt, by weight of Dry Mineral Aggregate, percent	14	13
Dry Mineral Aggregate, pounds per square yard	17	22

2.02 Emulsified Asphalt:

Polymer modified, quick setting emulsified asphalt (QS-P or CQS-P) shall be used. A minimum of 2% polymer solids, by total weight of polymer and asphalt residue, shall be added prior to the millhead. The type and amount of polymer solids used shall be certified by the supplier.

The polymer modified emulsified asphalt shall be preapproved and certified in accordance with ADOT Materials Policy and Procedure Directive (P.P.D.) No. 8, "Sampling, Testing, and Acceptance of Emulsified Bituminous Materials". As specified in P.P.D. No. 8, two copies of the appropriate certificate (Certificate of Compliance or Certificate of Analysis), conforming to the requirements of Subsection 106.05 of the specifications, shall accompany each shipment (delivery unit) of emulsion to the project.

The polymer modified emulsified asphalt shall conform to the requirements of Table 2.

TABLE 2
Polymer Modified Emulsified Asphalt (QS-P or CQS-P)

TESTS ON EMULSION	TEST METHOD	REQUIREMENTS	
Viscosity, Saybolt Furol seconds @ 77 °F	AASHTO T-59	20 - 100	
Sieve Test, retained on No. 20, %	AASHTO T-59	0.10 Max	
Particle Charge	AASHTO T-59	QS-P	Negative
		CQS-P	Positive

Storage Stability Test, 24 hours, %	AASHTO T-59	1.0 Max
Percent Asphalt Residue by Evaporation	Arizona Test Method 512 (1)	57 Min
TESTS ON RESIDUE BY DISTILLATION AASHTO T-59 (350 °F Max.)	**TEST METHOD**	**REQUIREMENTS**
Original Dynamic Shear of Residue @ 64 °C, G*/Sin δ, kPa	AASHTO T-315	1.00 Min
Penetration, 4 °C, 200 g, 60 seconds, 0.1 mm	AASHTO T-49	20 Min
Elastic Recovery @ 77 °F (25 °C), %	AASHTO T-301 (2)	55 Min

(1) The percent of asphalt residue will be determined in accordance with the requirements of Arizona Test Method 512; however, in the case of dispute the percent of asphalt residue by distillation (AASHTO T 59, modified to 350 °F) will be used.

(2) Testing shall be performed on residue by distillation, not on residue by oven evaporation.

2.03 Mineral Aggregate:

There is no Department furnished source of aggregate material. The Contractor shall provide a source in accordance with the requirements of Section 1001 of the specifications.

All sources of mineral aggregate must be approved in accordance with Section 1001 of the Specifications. This includes the submission and approval of an environmental analysis prepared in accordance with Subsection 104.12 of the specifications.

The Contractor or supplier shall furnish evidence that the aggregate material meets the above requirements.

Mineral Aggregate shall consist of sound and durable sand and/or crushed stone. The materials shall be free from vegetable matter and other deleterious substances. Aggregates shall be 100% crushed with no rounded particles. No natural sand will be allowed.

The gradation shall be __*__. The gradation of the mineral aggregate, when tested in accordance with the requirements of Arizona Test Method 201, shall conform to the requirements of Table 3.

TABLE 3		
SIEVE SIZE	**PERCENT PASSING SIEVES**	
	MIX DESIGN GRADING LIMITS	**PRODUCTION TOLERANCES**

	TYPE II	**TYPE III**	(See Note Below)
3/8 inch	100	100	----
No. 4	90-100	70-90	± 5
No. 8	65-90	45-70	± 5
No. 16	45-70	28-50	± 5
No. 30	30-50	19-34	± 5
No. 50	18-30	12-25	± 4
No. 100	10-21	7-18	± 3
No. 200	5.0–15.0	5.0–15.0	± 3.0

Note:
The allowable tolerance during production will be determined by applying the production tolerances to the mix design target values. However, the allowable production tolerance shall not fall outside the mix design grading limits in this table.

The mineral aggregate shall conform to the requirements of Table 4 when tested in accordance with the applicable test methods.

TABLE 4
MINERAL AGGREGATE CHARACTERISTICS

CHARACTERISTIC	**TEST METHOD**	**REQUIREMENTS**
Sand Equivalent	AASHTO T 176 (After thoroughly sieving the sample, no additional cleaning of the fines from the plus No. 4 material is required.)	Minimum 60
Carbonates	Arizona Test Method 238	Maximum 20%
Abrasion	AASHTO T 96	500 Rev., Maximum 40%
Fractured Coarse Aggregate Particles	Arizona Test Method 212	Minimum 95% (with at least one fractured face)
Uncompacted Void Content	Arizona Test Method 247	Minimum 45.0%

Tests on aggregates outlined in Table 4, other than abrasion, shall be performed on materials furnished for mix design purposes and composited to the mix design gradation. Abrasion testing shall be performed separately for each source of mineral aggregate. All sources shall meet the requirements for abrasion. If desired, abrasion testing may be performed utilizing the parent aggregate from each source. Historical abrasion values may be supplied on sources provided the testing was conducted within the past two years.

2.04 Mineral Filler:

Mineral filler, required by the mix design, shall be Type I or Type II Portland cement conforming to the requirements of ASTM C 150. The mineral filler shall be added in the approximate amount of 1% by weight of the total mix; however, the exact amount will be determined by the mix design. The source of Portland cement must be on the ADOT Approved Materials Source List, as referenced in Materials Policy and Procedure Directive (P.P.D.) No. 13, "Certification and Acceptance of Hydraulic Cements, Fly Ash, Natural Pozzolan, Silica Fume, and Lime".

The mineral filler shall be added to the slurry seal mixture by an approved method that will ensure uniform distribution and proper control.

2.05 Water:

The water used shall be free of any injurious impurities. Potable water obtained from public utility distribution lines will be acceptable. The contractor shall state the source of water.

2.06 Additives:

Additives may be used to accelerate or retard the breaking of the emulsified asphalt and the set time of the slurry seal mixture, or to improve the resulting finished surface.

Appropriate additives, and their applicable use range, shall be specified in the mix design.

3. Mix Design:

The contractor shall provide a mix design which has been sealed, signed, and dated by a professional engineer experienced in the preparation of slurry seal mix designs and approved by the Engineer.

Compatibility of the aggregate, mineral filler, water, additives, and polymer modified emulsified asphalt shall be evaluated during the mix design process.

All the materials used in the mix design shall be representative of the materials proposed by the contractor for use on the project.

The mix design must be approved by the Engineer prior to the start of slurry seal production. After the mix design has been approved, no material substitution will be permitted unless approved by the Engineer.

In addition to the other requirements stated herein, the mix design shall conform to the requirements of Table 5.

TABLE 5

PROPERTY	TEST METHOD	REQUIREMENTS
Residual Asphalt Content	ASTM D 2172	7.5% - 13% by weight of dry aggregate
Mineral Filler	----	Approximately 1% by weight of the total mix
Additives	----	As required for mix properties
Water	----	As required for mix properties
Wet Track Abrasion Test	ASTM D 3910	75 g/ft^2 maximum
Wet Stripping	ISSA TB-114	90% minimum
Slurry Seal Mixing Test, 70-85 °F, seconds	ISSA TB 102	120 Minimum
Slurry Seal Setting Test, 70-85 °F (1 hour cure)	ISSA TB 102	No Brown Stain
Slurry Seal Water Resistance Test, (70-85 °F, 30 minute cure)	ISSA TB 102	No more than slight discoloration
Cure Time Test, 60-70 °F, minimum	ASTM D 3910	12 kg/cm

The mix design must show the recommended proportions of aggregate, mineral filler, water, additive(s), and emulsified asphalt; and how the proportions are based (dry aggregate weight, total mix, etc). The mix design must also show the allowable production tolerance for residual asphalt content.

The mix design will also show the aggregate gradation, sand equivalent, percent carbonates, abrasion, fractured coarse aggregate particles, and uncompacted void content of the aggregate used in the mix design.

4. Equipment:

4.01 General:

All equipment, tools, and machines used in the performance of the work shall be maintained in satisfactory working condition at all times.

4.02 Proportioning Devices:

Individual volume or weight controls for proportioning mix components shall be provided and properly labeled. Proportioning devices shall be capable of determining the material output at any time.

The proportioning of emulsion, mineral filler, water, and additives shall be tied directly to aggregate flow.

4.03 Mixing Equipment:

(A) General:

The slurry seal mixer shall be a continuous-flow mixing unit, specifically designed and manufactured to be used for the application of slurry seals. It shall be capable of delivering water and also be able to accurately predetermine the proportion of aggregate and emulsified asphalt to the mixing chamber. It shall discharge the thoroughly mixed product on a continuous basis. The aggregate shall be pre-wet immediately prior to mixing with the emulsion. The mixing unit of the mixing chamber shall be capable of thoroughly blending all ingredients together. No violent mixing shall be permitted.

The mixing machine shall be equipped with an approved fines feeder that provides an accurate metering device or method to introduce a predetermined amount of mineral filler into the mixer at the same time and location that the aggregate is fed.

The mixing machine shall be equipped with a water pressure system and fog type spray bar, adequate for complete fogging of the surface preceding the spreading equipment, with a maximum application rate of 0.05 gallons per square yard. A calibrated control for aggregate and emulsified asphalt shall be provided and capable of proportioning accurately the material.

The machine shall be capable of a minimum speed of 60 feet per minute and shall not be allowed to exceed 180 feet per minute while in operation. Sufficient machine storage capacity to mix properly and apply a minimum of five tons of the slurry shall be provided.

(B) Calibration:

Each slurry-mixing unit to be used in performance of the work shall be calibrated prior to construction. Previous calibration documentation covering the exact materials to be used may be accepted, provided they were made within the preceding twelve months. The documentation shall include an individual calibration of each material at various settings, which can be related

to the machine metering device(s). No machine will be allowed to work on the project until the calibration has been completed and/or accepted.

4.04 Spreading Equipment:

The spreader box shall be equipped with a canvas or burlap drag to provide a rough surface texture. The drag shall be replaced daily.

Attached to the mixer shall be a mechanical type squeegee distributor equipped with flexible material in contact with the surface to prevent loss of slurry from the distributor. The contractor shall maintain the distributor so as to prevent loss of slurry on varying grades and crown by adjustments to ensure uniform spread. There shall be a steering device and flexible strike-off.

4.05 Auxiliary Equipment:

The contractor shall provide the necessary hand tools and any support equipment, which is exclusive to the slurry seal operation.

Areas, which cannot be reached with the slurry seal machine, shall be surfaced using hand squeegees to provide complete and uniform slurry seal coverage.

5. Construction Requirements:

5.01 Weather Limitations:

The slurry seal shall not be applied if either the pavement surface temperature or the air temperature is below 55 °F and falling, but may be applied when both pavement and air temperature are above 45 °F and rising. No slurry seal shall be applied when there is danger that the finished product will freeze within 24 hours following its placement. The mixture shall not be applied if weather conditions prolong opening to traffic beyond a reasonable time.

At any time, the Engineer may require that the work cease or that the work day be reduced in the event that weather conditions, either existing or expected, are anticipated to have an adverse effect upon the slurry seal.

5.02 Surface Preparation:

The contractor will provide for the cleaning and repair of the roadway surface prior to application of the slurry seal. The surface shall be cleared of all loose material, dirt, vegetation, and other objectionable material. The surface shall be cleaned and repaired to the satisfaction of the Engineer.

5.03 Mixing and Application of Slurry Seal:

The surface of the existing pavement shall be pre-wetted by fogging ahead of the slurry box. The water used in pre-wetting the surface shall be applied such that the entire surface is

damp with no apparent flowing water in front of the slurry box. The rate of application of the fog spray shall be adjusted during the day as the ambient temperature, surface texture, humidity, and dryness of the pavement surface change.

The slurry seal mixture shall be proportioned in accordance with the mix design.

The slurry mixture shall be of the desired consistency upon leaving the mixer and no additional materials shall be added to it. A sufficient amount of slurry shall be carried in all parts of the spreader at all times so that a complete coverage is obtained. Overloading of the spreader shall be avoided. No lumping, balling, or unmixed aggregate shall be permitted. No streaks, such as those caused by oversized aggregate, will be left in the finished surface. If excess oversize aggregate is encountered, the job will be stopped until the contractor proves that the situation has been corrected.

The slurry mixture shall possess sufficient stability so that premature breaking of the emulsion in the slurry seal while the mixture is in the spreader box does not occur. The mixture shall be homogenous after mixing. During spreading, the mixture shall be free of excess water or emulsion and free of segregation of the emulsion and aggregate fines from the coarser aggregate. Spraying of additional water into the spreader box is not allowed.

The contractor shall remove slurry seal from any area specified by the Engineer.

The contractor shall remove any debris associated with the performance of the work on a daily basis.

5.04 Protection of Existing Fixtures:

The contractor shall take all necessary precautions to prevent slurry seal or other materials used in the work from entering or adhering to gutters, gratings, hydrants, valve boxes, manhole covers, catch basins, bridge or culvert decks, permanent road markers (ceramic and reflective), and other existing fixtures.

Immediately after surfacing, the contractor shall clean and leave existing features in a condition satisfactory to the Engineer.

5.05 Joints:

No excessive buildup, or uncovered areas of unsightly appearance, shall be permitted on longitudinal or transverse joints. An excessive overlap will not be permitted in longitudinal joints. The contractor shall provide a minimum number of longitudinal joints throughout the project. When possible, longitudinal joints shall be placed on lane lines. Half passes and odd width passes will be used in minimum amounts. If half passes are used, they shall not be the last pass of any paved area.

5.06 Handwork:

Approved squeegees and lutes shall be used to spread the mixture in areas inaccessible to the spreader box and other areas where hand spreading may be required.

5.07 Damage to the Slurry Seal:

It shall be the contractor's responsibility to remove and replace slurry seal which is damaged prior to the final acceptance of the work.

6. Sampling and Testing Requirements:

Mineral aggregate shall be sampled in accordance with Arizona Test Method 105.

At least two weeks prior to the start of slurry seal production, the Engineer shall obtain a representative sample of mineral aggregate for testing. The material shall be tested for gradation in accordance with Arizona Test Method 201, and shall conform to the production tolerances shown in Table 3. The sand equivalent, fractured coarse aggregate particles, and uncompacted void content shall conform to the requirements of Table 4. If the mineral aggregate does not meet these requirements, production shall not begin until the mineral aggregate is in compliance with these requirements.

For each 300 tons of mineral aggregate used in slurry seal production, the Engineer shall obtain a representative sample of mineral aggregate for gradation and moisture content testing. The material shall be tested for gradation in accordance with Arizona Test Method 201, and shall conform to the production tolerances shown in Table 3. Should testing indicate results not meeting these requirements, operations shall cease and the contractor shall have the option of providing a new mix design or correcting the deficiencies. The material shall be tested for moisture content in accordance with AASHTO T 265.

For each 600 tons of mineral aggregate used in slurry seal production, the Engineer shall obtain a representative sample of mineral aggregate for the determination of sand equivalent, fractured coarse aggregate particles, and uncompacted void content. The material shall conform to the requirements of Table 4 for these test characteristics. Should testing indicate results not meeting these requirements, operations shall cease and the contractor shall have the option of providing a new mix design or correcting the deficiencies.

During slurry seal production, a representative sample of the emulsion shall be obtained for testing to determine the percent asphalt residue by evaporation. A sample shall be obtained, in accordance with Arizona Test Method 103, from each delivery unit of emulsion by the contractor and witnessed by the Engineer. The emulsion shall conform to the requirements of Table 2 for percent asphalt residue by evaporation.

7. Method of Measurement:

Emulsified asphalt will be measured by the ton.

Mineral aggregate will be measured by the ton, excluding the weight of any moisture.

8. Basis of Payment:

The accepted quanities of emulsified asphalt, measured as provided above, shall be paid for by the ton.

The accepted quanities of dry mineral aggregate, measured as provided above, shall be paid for by the ton.

Payment shall be full compensation for all surface preparation, mixing and application of materials, and for all labor, equipment, tools, cleaning, and incidentals necessary to complete the work as specified herein.

No direct measurement or payment will be made for water or mineral filler, the cost being considered as included in this contract item.

DESIGNER:

***** Specify whether the Mineral Aggregate Gradation shall be "Type II" or "Type III". Consult with the Pavement Design Engineer prior to specifying the gradation type.